Assignment 6
Structured Products

Case study: Certificate Pricing.

On the 31st of January 2023 at 10:45 C.E.T., consider Bank XX possible issue described in Annex 1 and the hedging swap in the Annex 2.

Use in the valuation a VG model (suppose that interest rates and EURO STOXX dynamics are independent). For the VG parameters use the ones obtained in the calibration of previous assignment and discount factors of Assignment 2.

Questions:

a. Value the upfront X% that the bank should receive under mid-market conditions.
b. Model selection: in order to price this issue is it possible to use a different model? How much is the upfront in this case?
c. If the structured bond is with a three-year expiry, with the same payoff for the first year repeated also on the second one and Early redemption option at the end of first two years, is the alternative of point b. still available?
d. [facultative] Value X% of point c. under the hypothesis of same VG parameters and deterministic IR, same dividend yield of point a. and discount factors as in Assignment 2. [Hint: consider the dynamics for the underlying corresponding to the forward].
e. [facultative] Which would be the error using the Black model (e.g. using the implied volatility for the strike of interest)?

Exercise: Bermudian Swaption Pricing via Hull-White.

On the 31st of January 2023, using Euro market data (versus Euribor 3m), consider a 10y Bermudan yearly Payer Swaption Strike 5% non-call 2 (i.e. the swaption can be exercised every year starting from the 2y, the underlying swap ends on the 2nd of February 2033). Consider a single curve framework and a 1-factor Hull-White model with $a = 10\%$, $\sigma = 0.8\%$.

a. Price via a tree (equally spaced in time) for the underling OU process: it is suggested to insert a variable that controls for the precision (e.g. number of steps in each interval).

b. Is there a way to check that the tree has been correctly implemented?

c. [facultative] Consider an upper and a lower bound for the swaption. Price them with the Jamshidian formula.

d. Compute the coarse-grained DV01 (2y, 5y, 10y) and hedge the delta with Mid Market Swaps (2y, 5y, 10y).

Discuss the results.

Hint. Implement the tree for the zero mean OU variable. Use the Main HW relation.

ROBERTO BAVIERA
POLITECNICO MILANO
E.Mail: financial.engineering.polimi@gmail.com

Annex 1:

Indicative Terms and Conditions as of 31st January 2023

Issue Termsheet

Principal Amount:	100 MIO EUR.
Issue date:	31st of January 2023
Issue price:	At par
Start Date:	2 Feb 2023
Maturity Date:	2 years after the Start Date.
Bank XX pays:	Coupon
Coupon:	Payable annually on a 30/360 (mod. foll. adjust.) day basis: Year 1: 6% if Stoxx50 < Strike at Coupon Reset Date Last Year: 2%. The Coupon shall be subject to the Early Redemption and Final Coupon clauses.
Coupon Reset Dates:	2 Business Days prior to the respective Coupon Payment Date (i.e. **in arrears**).
Strike	3200
Coupon Payment Dates:	Annually, subject to the Following Business Day Convention.
Early Redemption:	If on a respective Coupon Reset Date, the Coupon reset is such that the Cumulative Coupon Accrual would be equal or above the Trigger Level, the Notes will automatically redeem early on the respective Coupon Payment Date at a price of 100% of Par.
Trigger Level:	6%.
Cumulative Coupon Accrual:	The Previously Paid Coupon Percentage plus the originally scheduled Coupon payment based off the respective Coupon reset on the respective Coupon Reset Date ignoring the Trigger Level clause (expressed as a percentage of the Principal Amount).
Previously Paid Coupon Percentage:	For a respective Coupon period, the sum of all previously paid Coupon payments on the previous Coupon Payment Dates expressed as a percentage of the Principal Amount.

Annex 2:

Indicative Terms and Conditions as of 31st January 2023

Swap Termsheet

Principal Amount:	100 MIO EUR.
Party A:	Bank XX
Party B:	I.B.
Trade date:	today
Start Date:	2 Feb 2023
Maturity Date:	2 years after the Start Date.

Party A pays:	Euribor 3m + 1.50% The Swap shall be subject to the Early Redemption and Final Coupon clauses.
Party A payment dates:	Quarterly, subject to Modified Business Convention
Daycount:	Act/360

Party B pays @ Start Date:	X%
Party B pays:	Coupon
Coupon:	Payable annually on a 30/360 (mod. foll. adjust.) day basis: Year 1: 6% if Stoxx50 < Strike at Coupon Reset Date Last Year: 2%. The Swap shall be subject to the Early Redemption and Final Coupon clauses.
Coupon Reset Dates:	2 Business Days prior to the respective Coupon Payment Date (i.e. **in arrears**).
Strike	3200
Coupon Payment Dates:	Annually, subject to the Following Business Day Convention.
Early Redemption:	If on a respective Coupon Reset Date, the Coupon reset is such that the Cumulative Coupon Accrual would be equal or above the Trigger Level, the Swap will be automatically cancelled.
Trigger Level:	6%.
Cumulative Coupon Accrual:	The Previously Paid Coupon Percentage plus the originally scheduled Coupon payment based off the respective Coupon reset on the respective Coupon Reset Date ignoring the Trigger Level clause (expressed as a percentage of the Principal Amount).
Previously Paid Coupon Percentage:	For a respective Coupon period, the sum of all previously paid Coupon payments on the previous Coupon Payment Dates expressed as a percentage of the Principal Amount.